INTERVIEW WITH JOHN D. (DENNY) HOLT
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1. Dunar  What we're looking at doing with this is trying to
get the JSC perspective on what has gone on in Space
Station.  We've been getting the Marshall perspective of
course, and we're just trying to see a little bit of the
other side of the relationships and such, critical
relationships.  If I could ask you to tell me a little bit
about what you have done on Space Station and the nature of
your contacts with people from Marshall.


2. Holt  I've had on Station, I worked with Skylab also back
in the experiments days so I had to work with Marshall back
in that time frame also, the early '70s.  On the Station,
most of my background is in operations.  I originally came
into this organization to put the project hat on the
operations development at JSC.  I had the cash and the
schedule from here.  That was kind of a change for JSC.  The
whole culture of this program was a different culture.  The
idea that a project office would somehow fence off JSC
institution from Headquarters and provide that oversight.
It didn't work, and it hasn't worked at Marshall either.
Everybody had struggled with the structure of this program
and to a great degree, Marshall has probably always been a
little more resistive than JSC has to the program

penetrating it.  JSC has always fostered the "let's go get

them," and "we want to go find out a program and search out

every nook and cranny and do as much work as we can."

Marshall's always been much more regulated with a thing that

says "we want a set of requirements and we're going to work

it this way and when we can meet your requirements we'll

come tell you."  The difference in culture there is quite

dramatic, and I've worked with Marshall on Spacelab payload

missions when I was running federal operations for MOD and

then also back in the Skylab days when we were doing payload

operations and we actually operated the experiments that

Marshall built.  The split on this program was along the

lines of Spacelab to where payload operations is Marshall's

job and spacecraft operations and of course systems

operations is a JSC job.  Apparently, that's borrowing on

the Spacelab model.  Skylab we did all the operations at

JSC.  Marshall has been very effective in changing their

center culture away from just power and thunder to also

doing a lot of work for the science community, building

payloads, and operating them.  In as such, they've made

quite a niche there, and they've exploited that niche pretty

effectively.  In fact, back at the end of 1989 in some of

the cost cutting we were doing, we had quite a bit of

conversation with Ray Tanner as program director at that

time over cost saving measures.  One of the ideas was to

consolidate at least on the front end of the program, the

federal operations activity in Huntsville with the control

center here at JSC and not build another facility and not expand the POCC over there until a later time. Pretty much that was perceived as a run on jobs in the Huntsville area and it progressed under Coors after the big Langley hurrah. We did first big round of cost savings after we've finally got everybody on the contract. We had presented some cost options and Marshall, Jack Bullman pulled together for Fletcher Kurtz back in those days and Carolyn Griner was in Huntsville of course at Level 1 and then ultimately went back. I pulled together the JSC story what it would mean to use their existing infrastructure. Jack Bullman said "Here's what we're putting on the table in terms of development." The costs racked up at a quarter of a billion dollars over seven years versus a billion dollars over seven years. It was pretty much admitted, Marshall knew that if it came down to just a pure cost story, it was going to get in trouble. It came down to a "Well we decided that we're going to go ahead and stay with a baseline program" which I think had a lot to do with the fact that the minute you put a thousand jobs on the table then there are those who get interested. We understood that interest went as high as Senator Heflin, so it's not unexpected. That's been one of the things that you see when you get into the programmatics especially in this program. There's been so much discussion about balance between JSC and Marshall. If you look historically they've always been within 50 jobs of each other. I'm sure you've heard that in the past that says

that we've always had to maintain a balance between the two
centers.  That's probably my story that adds to the thing
that says regardless of the cost, if you upset the apple
cart than you're getting into the balance too much there.
The minute you tread over into political territory then the
answer comes out with a little thing that says this is the
answer and we're comfortable with the baseline program as is
regardless of cost.  That's kind of what we did.  There has
not been acrimony.  Quite frankly, at the working level, the
culture, I mean we've never had a problem of getting to an
answer with Marshall.  Typically it always comes down to a
point in time where it says philosophical differences aside,
what can we now do since its at the last moment that we have
to do something.  It's always had that flavor to it.  The
two managements have tended to want to not go solve the
problems so much as they've let the technical solutions
bubble and then go in at the last minute and make decisions.
I think that's been almost the modus operandi of
Marshall/JSC operations over the whole time I've been
involved.

3. Dunar  One of the things we've found and it's not just
peculiar to Station, but we've found that there seems to be
a lot of acrimony between the two centers at the beginning
of a project when you're dividing pies essentially and maybe
things get better once the pie is divided.  Is that true in
light of the Station thing?

4. Holt   Sure.


5. Dunar   I guess one thing that makes Station different is
that with all the redesigns and rescoping everything is that
you go through that process more than just at the beginning
of a program.


6. Holt   You always end up, and we're there today, to where
one of the most difficult arguments we had in the early
requirements days on the design was over the definition of
the data management system.   JSC has always looked at things
from a standpoint of we want to preserve flexibility within
the operations.   I think probably everything JSC does is
from a standpoint of ultimately we have the operator here
and we have to satisfy him.   If we err in our design
approaches it tends to be on the side of adding flexibility
and covering more bets.   Marshall is much more driven toward
a thing that says "I have a set of requirements and I'm
going to build this thing to where it meets that set of
requirements and if you don't like it you can come visit me
at my design reviews and we'll discuss it at that point in
time."   They've been more effective in going about a
classical design than JSC has because we are over half
operations of this center by the time you take all the
agendas into place.   We tend to get penetrated at a lot of
levels, and our contractors know that so they strive very

much to get an [097?] perspective going through.  Marshall

tends to then, the DMS for example, they had gone out and

gone with a lot of imbedded data processors which makes good

sense.  I mean if you want to build it one time and operate

it that way.  The concern we had was that the Space Station

tends to go together in pieces, and you know you're going to

be reallocating the data management resources over time as

you want to move off of the initial checkout and go to the

operational phase where you need less data on the basic

system and more band width and extended payloads and all.

We were always looking toward the how to make it grow and

Marshall was always looking for how can I build it and

freeze the content and get it done, checked out, and

delivered.  From that standpoint I think that Marshall has

always been more of a, they viewed their contract with the

program as a contract and as a deliverable to the program.

JSC has always viewed it more as an activity and a design

improvement, and we'll work on it, work on it, work on it,

and then we'll get as good as we can get.


7. Dunar  That describes maybe the relationships between the

centers and their contractors more than between each other.


8. Holt  No it actually effects each other also because the

difference in working groups run on this program, whoever

has the center of activity for a system development like

Marshall has the UCLSS.  They also have the manned systems

even though most of the manned system, or at least the guys
who at least think they're manned system reviewers are here.
That's always debated at Marshall.  The DMS working groups
were here.  GNC working groups were here.  If you look in
this program, the architectural control documents which are
in effect the functional specifications, you may get ready
to see CD come up in a couple of places, but those are the
NASA spec that ties together the work factors so in the
classical design that would be the CEI spec and then there
would be contractor and contractor's specs below that CI
spec.  In effect we had to create a spec for system
development.  Like on the audio system that is delivered by
Marshall, but the com-system is JSC as the overall
architect.  So you have two, Boeing has a CEI spec and
McDonnell Douglas has a CEI spec.  It's all tied together by
ACD, architectural control document.  That is the NASA spec.


9. Dunar  Is that comparable to the interface control
documents in Shuttle?


10. Holt  No.  We still had ICD, but that is the definition,
the bulk of what that configuration must be both patterns
and actions.  This is the functions.  This is the thing that
says the wires string this way, there's this many buses,
there's a device here.  It's more of the end item
specification for a system that you'd buy because in this
program, since NASA is the prime, we had to invent a layer

of documentation which has almost been a travesty in the way
it's been, it's gone backwards.  It has led to, the ACDs
never had real standards applied to them or any standards
applied to them.  Quite frankly they vary from something
like that to about the DMS ACD is almost a foot thick, maybe
a foot and a half.  The ABA is about half an inch to an inch
and the formats are different.  A Lewis-developed system for
the electrical power system is so much different from UCLSS
and so much different from the [142?].  They're not the
same.  The horizontal integration on this program which was
supposed to have been done by the program contractor or done
by the collaboration of primes has not really been
effective.  A lot of that had to do with the fact that after
level B, Restin never really got up and running.  On this
program, I think as much trouble as JSC and Marshall always
have, it's always been more of a fun thing that says "we're
better than you are and we'll compete with you over the
right ideas and how to do this and you guys are wrong.  You
stodgy old Germans and you bunch of wild-eyed Air Force
brats."  It's just that type of thing that went back and
forth until we all ended up with Restin and realized that
any problems that we had in the past are almost nothing
compared to what we've got now.  In a lot of cases, it was
almost impossible in this program to go underground to work
something.  We, Jim Odom, had the best idea in this program
and actually came in with proposed associate contractors
that says I will centovize primes to get together and work

things out so the fewer problems that come to government,
then I'll incentovize you with [160?]. As soon as Odom and
Tanner left, that went away overnight. Restin took that
apart in five seconds.

11. Dunar  Was that at the same time that the lead center
concept . . . ?

12. Holt  After that. The lead center at level B, Tom
Mozer, was actually the first program manager. He's out of
JSC. Tanner went up from Marshall. You get a lot of
differences of opinion. I think probably from our
perspective, the way a JSC program manager works, the real
difference in the project sense of development, is the
difference in the chief engineer. The chief engineer at
Marshall, man he is an engineering guy. He is owned and
operated by the director of the S&E labs. At JSC the chief
engineer tends to be in the project office and not in
engineering. JSC engineering has not had as strong SE&I
activity as Marshall does within engineering. The project
functions and program functions here tend to be large. We
tend to co-locate in a lot of cases, but almost always they
are under direct control of the program manager.

13. Dunar  So JSC does not make use of a matrix type?

14. Holt   Yes it does, but it's different in the effect that you don't have the chief engineer who actually issues technical direction.  All technical direction is back in the project office and all contract direction is through that same channel.  It tends to mean that at Marshall George Hopson is involved when cost, the schedule, and the requirements are threatened, and Dave Mably runs the day to day activity.  George has a small office, 40 people 25 people, and John Erin, Jack Vorkin has always had close to a 100.  SE&I has always tried to be associated with the project office.  JSC is working on trying to make some changes in that area, but historically engineering has been technologies, and then the center has tapped those technologies.  It got a lot stronger going during Shuttle when we didn't have any other programs going so therefore SE&I coordinated the program.  There was not lot of reason for engineering [189?] SC&I was all one big happy family at the center.  This Station program not having a SC&I in it has been the real killer.  When level B went to Restin, the SC&I died in this program.  Therefore you end up with standards being different on different contracts, no common content within the contracts.

15. Dunar   Wasn't moving it to Restin supposed to avoid that?

16. Holt  Yes, but a lot of what happened was the guys that invisioned the move to Headquarters, experienced program people and not that many of them moving up there, invisioned that system engineering could exist at that level, but not system integration.  The mistake made with trying to pull system integration at the headquarters level without having people who could do hands on and they just had to fill too much of a team too fast.

17. Dunar  The systems integration statement seems like an incredible nightmare.

18. Holt  It is.

19. Dunar  With the different work packages and trying to protect political consistencies.  Could you comment on that?

20. Holt  Yes, it's impossible.  It literally gets down to a question all across the board until you are absolutely faced with "we have to get off the dime."  Then nothing happens.  Typically in this program what has happened to us is, and a lot of the reasons that we've taken as much heat as we have in Work Package 2, is the fact that we had to be there first.  Marshall had the luxury of sitting back knowing that the schedule for the node and the schedule for the lab was never going to be there, and we had to be there with all our stuff before they ever got there any how.  So we were always

under the gun to force the issue on scheduling to try to get

agreements on what the configuration would be and the very,

very details of the ICD.


21. Dunar  You probably had to face costs crisis first?


22. Holt  Oh yes, and we've worn our share of the burden for

that.  We've really paid dearly for moving out assuming that

we had to do the right thing and get it over with and that

we would be taken of, and we were taken care of all right.

I think that probably what happened was that John Erwin

always viewed that you could sit down across the table with

George Hopson and cut a deal and that deal was done.  What

largely happened was though that the two-tiered system at

Marshall, John was, if he chose to be, Chief Engineer and

Project Manager.  He could do the deal right then.  Turn

right around and tell Mike Jackson without any engineering

input, "I want to do this.  Move out." George always had

engineering input so he always had a constituency that was

looking behind it before he got there, and George was always

slower to commit than John was because John was always

working the engineering along with the project and George

was always asking Modly what the answer was.


23. Dunar  Which system do you think was more effective?

24. Holt   In this program, I think the problem is that the
mix of the systems.   If you want to get something, if you're
really faced with tremendous schedule pressures and cost
pressures, then they both have disadvantages to where we've
been.  We've had tendency since John was King in everything
else, I mean he could literally go in and eviscerate a
system if he wanted to, move all the testing out and do
whatever.  He had total control.  The Marshall system would
never allow with Dave Modly or George to have that total
control.  From that standpoint, there's probably a much more
conservative and cautious approach out at Marshall that says
that we will be back to the program if we can't deliver on
this thing.  With JSC I think we've always tended to take
the challenge, move out, find out that that didn't quite
work, go back and ask for forgiveness.  Forgiveness is
getting pretty tough in today's times.  I think in the way
government service is going, the way NASA's going, that the
only way that centers are going to be able to survive is to
adopt pretty a Marshall style of management that says you
have a project office but that project office does not have
autonomy and neither does the chief engineer.  In the scheme
of today since you're going to be working largely, the
project guy will probably be at Headquarters anyway, then
you'll want smaller offices.  Luther Powell, if you go back,
I don't know if you talked to Luther or not, but Luther
tried to change the Marshall culture.  He tried to put in a
100 man office over there.  He was gong to run it JSC style

in effect, and they took him apart and got him back to

something that's smaller.  I think JSC right now in the

organizational lookings that it's doing recognizes today

that in a day when cost is more than just a measure, it is

actually something you can get fired for, then JSC will go

back now and start to look at, we're looking at different

management organization approaches.  It will go back, we

can't organize quite like Marshall because we've got such

proponderence of STS here, but we will probably end up

organizing along a Marshall with a Goddard projects office

flavor to it.  Something that has a directory to the whole

program.


25. Dunar  Is the center environment going to change the

traditional [267?] of the center's being semi-autonomous?


26. Holt  Yes.  In effect it may give you, it probably gives

you more autonomy for design because you go back to a prime

contractor.  That's been the real gut wrenching issue here

is, when you take the documentation and you go in and look

at the interpretation one level down, we could never accept

the program requirements as written against the contract.

All of the work packages today have exclusions that they

have laid on to where they could not meet the program

requirements.  The program requirements are laid out as a

fairly big document.  They have tons of applicable documents

associated with them.  The program wants to operate on a

thing that says the current issues is the program
requirement.  No contractor will do business with you on
current issue that says "Hey, don't worry I'll just send it
to you, but it's OK."  They want to know date, times, what
changed.  From that standpoint, there's always been, the
program will always exist unless it actually gets into
management contracts, will always be a little bit nieve in
terms of what is possible and how quickly you can determine.
The closer you get to a milestone, the more critical it is.
If you want to wave the requirements, hell you can get a lot
done, but the program is very proud of its requirements.  It
has QA guys standing by with red stamps all over everywhere,
and they'll bookkeep you to death.  The minute, if you
really want to reinvent and you want to get something
simple, you have to get to a very very succinct government
speciality, very, very simple statement of your
requirements.  Then you have to put your emphasis on what
the contractor interpretation of that was and how you
intended to verify that.  I think that in no place is the
difference between JSC and Marshall is as pronounced as it
is in avionics.  We have, the shuttle avionics was such a
monster and the ability to fly, you couldn't afford a
hiccup.  It had to fly all the way to the ground.  So that
culture then that says check, check, check, test, test,
test, big facilities with flight computers in them with
flight tapes even within the training facilities, was the
right answer for shuttle because it was a production

vehicle.  For station, we are now back to where the shuttle
avionics crowd had their cut in this program and the
unbroken string in the latest round.  You went through Arnie
Aldridge who ran the orbiter project office and the orbiter
avionics development.  Dick [305?] who did systems
integration but a lot of that was avionics. Bob Moorehead
who had worked for Arnie and did avionics office.  John
Aaron who did space craft software under IBM contract.  Dick
Thorston who was over Mission Operations at JSC.  Harold
Dawson who worked at Level I as Moore's deputy and Eldrid
McKinnley was the next guy when John Aaron moved on through
Space Station.  He became the space craft software division
chief.  So if anything happened in that world, it was more
group think than anything.  That has been, because the
emphasis all of a sudden on facilities and big test rigs is
really been probably is the one real difference in the way
we were headed under Tanner which is the Marshall philosophy
we don't need all that integration testing, all these
avionics, we're going to go through an interface.  I want
this stuff just swapping back and forth.  Some of this stuff
we'll fix it and get on order.  That is so anti-the Shuttle
model that says no any bit that changes in the computer has
to be trapped.  Typically in station the risk is in the
[plane flew overhead 325?] sounds.  You're working on trying
to get our redundancy established so you don't have a full
system.  Everything starts to shut down on you or you run
into problems not being able to complete something then we

worried since you were all computer controlled that you had to check that very carefully.  For the lab environment downstream that's probably right.  You could probably turn the thing off and it would slow roll around for an hour or so and turn it back on.  Even if you lost control you could establish control and that would be heresy in some parts of JSC.  The fact that anybody would let a manned vehicle float out of control for ten seconds would be heresy.  There is probably nothing that illustrates the difference there Bob Moorehead was willing to pay which was another $300,000,000 worth of facilities to go do the total avionics integration to where Tanner was not willing to pay even for what was originally on our contract back in 1989 and issue directions for us to delete.

27. Dunar  This is really fascinating stuff and in a way it runs counter to the image of Marshall's culture in the sense that the tradition of Marshall being to test everything to death.

28. Holt  Except in the software, but they want it fixed. You see JSC always assumes that the software is gong to fluid and Marshall wants it fixed and they want it deliverable and they want to test their configuration and get it out.  That's what you buy.  Marshall tends to focus only in [346?] and  JSC tends to focus on the idea.

29. Dunar   That's interesting.

30. Holt   Yes, so when you get into the business, Marshall
is the manager of the ICD's in this program and JSC is the
manager of the architecture.   What's the idea of how the
Space Station ought to go?   Well it's how the systems work.
What's the hard reality of you how put it together?   It's
what bolts to what.   I've kind of been, this office has been
kind of interesting in that regard because the ICDs where
the nodes were they are in the program.   Boeing builds the
nodes delivers it to JSC but we're responsible for the
interfaces and interface definition.   In my office, almost
all the interfaces, we do almost all the ICDs for the whole
program, but I'm doing them for Denny Cross over in
Huntsville and Jim Bean, and back to Dick Thorston, who is
resident here.

31. Dunar   How do you work that out?

32. Holt   Actually what we've done is we've gotten an
interface working group, and we have had less problem
working with those guys than working with the ACD guys
locally.

33. Dunar   Why?

34. Holt   Because, it's a difference between what's concrete and what's theory.  Then somewhere along the line, someone made a mistake of deciding that because a piece of a system like am MDM or a CMG or firebox or whatever was part of the "system" and then those interface definitions ought to be part of the ACDs.  Quite frankly the guys down here don't care about that stuff, don't really care about it.  We managed a bunch of that, and Dale Thomas manages the other piece for Work Package 1.  Quite frankly I'd like to go mix it all into one soup and just have one organization managing all interfaces and if I were going to pick one it would be the guys in Huntsville rather than the guys here.

35. Dunar  It would seem if you have a change in a ACD it would have a ripple-out effect?

36. Holt   It does but since a lot of the element interfaces are like a bus hooking up not, if the box weighs so much and has this kind of bolt pattern then I go pick that and I go figure out how to go put it in a fit segment.  The element then is a fit segment for example and it bolts on to something.  That's the element level that Marshall manages.  The system level JSC has the management for.  But see that was another one of the splits.  That was the Bill and Orr fix.  I'll draw you a picture.  If you go back to when at the end of Odom and Tanner, and in fact I'll be honest with

you I think that the day Jim Odom left was the day they cast the fate of the Space Station.

37. Dunar   Can you elaborate on that?

38. Holt   Yes, we had to start over again.   You had finally a guy who had the perspective of how it ought to play together and how it would be engineered, and then he had Tanner as a hammer.   Ray was the ultimate lightening rod. Heat never bothered Ray, and the only guy who could really control Ray was Odom.   From the political side of Stophan and Mozer, then Mozer destroyed the requirements phase. When we did program requirements review what should of just been an opening the doors of Restin and building the square on a milestone turned into 7,000 discrepancy reports written against the basic requirements document.   They had processed 7,000 changes to the program requirements.

39. Dunar   This was done by Headquarters?

40. Holt   Yes, that was the initial Restin fix.   Instead of taking the Level B documentation which was about the right level, because it had been argued by all of us, they took it and processed 7,000 changes.   Added detail that you couldn't' believe.   We turned around with our contract and were ordered to go blow that stuff into our requirements spec.   We ended up incurring a $40,000,000 claim from

McDonnell Douglas on a brand new contract just to process
paper.  We hadn't even put a design on the table.  All that
we had was a proposal.  But, they knew how to get well, and
Boeing did the same thing to the guys in Huntsville.  When
Lenore came in after Odom, Restin, the SC&I was not working
well at Restin.  The SC&I never reported to the Program
Manager at that time.  When Truly took over as
administrator, he crushed the Agency back together where
Lenore on the Station and the Shuttle.  (He's drawing) STS
over here and SS over here.  Well that put it all back in
Code M.  I don't know whether you guys have gotten into that
but Code M is the institutional mother of Space Station of
JSC and Marshall and Kennedy.  The [441?] are bought and
paid for by the Code Ms.  So all our programmatic dollars
and all our base of facilities of support is based back
through that Headquarters code.  Andy Stophan had operated
it as a separate organization and had run Station so in
effect he was having to buy matrix effort out of Code M out
of Truly.  It wasn't working worth a damn.  Didn't work good
for Culberton, didn't work good for these guys.  What Truly
did was shove two programs together and now the whole
engineering base of JSC and Marshall and whatever slice of
Lewis you needed was back as one entity.  You put the Center
Directors in the chain in effect that says "I won't tolerate
Jack Lee and Thorn not paying attention to what's going on."
Now, we're back to the split it apart again.  That's been
the real argument that we had, and that's been a

destablizer.   This thing (drawing) stabilized this critical
relationship.

41. Dunar  It was necessary what Truly did in terms of bring
together what would have just . . . ?

42. Holt  Yes, it was ready to float.  It wasn't going to
work.  At that time, that's when we moved from the sticks
and balls assembly approach to the preintegrated truss.  You
couldn't have done that without the STS involved.  You had
to get a commitment for the Shuttle to know what you're
flying, when you're flying it, and how you put it together.
So in this case we took a lot of the things like we threw
out the EVAs that we were going to develop with Station
money that went to Shuttle.  So we started looking at
lapsing a lot of things back to what we already had
incoordinated, and that was Lenore who was able to go force
that because he had both sides of the program.

43. Dunar  Was part of the motive behind that then was to
preserve costs protection I suppose?

44. Holt  Yes.

45. Dunar  In other words, you could shift things to the
Shuttle program.

46. Holt  Of course the risk on that is that you've got guys like Gus Ferrel at Lockheed that spends a lot of money developing a bid hoping to get an EVA and now you just took away from him for buying Shuttle.  Then you tick off the industry phase.  Any time you use something with an awful lot of money [482?].  But here's kind of what had happened as to how we ended up with two camps.  It was all trying to be run out of Restin.  We had about 50 civil servants here, one of the larger organizations.  There are only about 200 civil servants at Restin.  I think it peaked out at around 250.  There were 450 SC&I contractors, and it was absolutely not happening.  So they dropped down a notch and brought in Thorston and they integration field center operations at JSC, Marshall, and Lewis.  Lewis was kind of a throw down to get them to salute, but this effort here was about 500.  The plan was, JSC and Marshall got together and split the baby.  Literally.  We've got the charts that says this goes to you this goes to us.  It got down to the things that systems are ours so therefore, that type of thing.  (starts drawing again) This was then a split of some seat, drawing contractors, and in our case my guy on a different contractual arrangement, and the same thing here you see with Boeing.  Over here was a seat for Lockheed or Rocketdyne.  So they set up, this was supposed to provide horizontal integration to the program, and this was supposed to go away only it didn't.  So we added 500 [514?].

47. Dunar   At the centers?


48. Holt   At the centers regularly reporting and not
building hardware just to do systems integration.  Nothing
went away.  In fact if anything, that a man went up more and
more to feed the monster and then on top of it we put in
Burt Jackson up here to do Configuration Management, took
this bunch from 50 to about 150 so we added another 100
[523?].  So when you start looking five years worth of this,
since about '89 I guess, then there is a fair size chunk of
change that's gone into this overhead.  This right here, and
a percentage of that finally started paying off but it took
four or five years to get it to where it had some
capability.  This was Lenore's cut here that says I'll give
Elements to Jim Bean and I'll give Systems to Carroll Dawson
down here and that was the split between the two centers.
This was the architecture of the ACD management.  This was
the ICD manager kind of thing over here called the BCD which
is Baseline Control Document which is nothing more than the
top level [541?].  But that is, so hard products here and
systems over here.  We had ended up in the middle of every
argument because the node tends to take APM or Jim or the
lab or the hab on this side wherever it happens to connect
all the interfaces back to the truss and the truss has all
this interfaces to hold transport the Canadian Arm.  We had
become conduit for all arguments with the international.  In
effect work phase 2 had all the systems responsibilities and

all the interface responsibilities since I got a lot of this
dealt with by Marshall back to us here to be the prime
contractor and literally we took the beating that prime
contractor would normally be.  And it's "What do you mean
you can't deliver on time" and "What do you mean you've an
18% override."  It's that kind of perspective that you get
into and the fact of the matter is that the work values
pretty much commiserate with each other.  Tremendous amount
of cooperation between George Hopson's office and ours in
terms of settling differences on the element on the
interfaces.  We ran bilateral agreements on all of them and
piled them up like crazy and they issued technical direction
and contract direction and [576?] and most of the swaps we
made with George cost us.  We were on the losing end in damn
near all of them because we had schedule pressure and he
didn't.  We were on the loosing end with Lewis strictly
because there was pretty much a perspective at JSC that
Lewis is incompetent, and they've not done manned
operations.  Incompetence is probably too strong a word, but
with their inexperience and with Rocketdyne's inexperience
in the power system, both Marshall and JSC have been just
scared to death that they wouldn't [590?].  So if there's
one thing we all agree is that introducing major new element
to the new program, those guys, it's taken them a while and
we've been very very concerned about them missing a step
here and there.

49. Dunar   Just without the experience?

50. Holt   Yes, and you don't have a good practiced argument
those guys in Cleveland!

51. Dunar   You had one for Huntsville for years?!

52. Holt   Yes, and I used to explain this to John Erwin this
way.   He'd talk about "Well I need to get to George and I
need to do this."   I'd say, "Well I talked to Jack Bulman
and he said 'Well I'd kind to know what you guys are going
to talk to George about because John tends to go into the
meetings a whole lot better prepared than George does and
we'd kind of like to have the opportunity to talk to him
before you get to.'"   You see there was always this behind
the scenes of let's make damn sure because they were nervous
that George would get in there and get committed to
something that he didn't understand because he was afraid
John was going to take him!   We always had that going on,
and John would always take about getting it from George and
I'd say, "Now John you've got to understand.   George is not
Chief Engineer and Project Manager.   George doesn't do
business the same way you do."   We'd talk for a while, and I
finally explained it to him one day.   I said, "Those ol'
boys in Northern Alabama have been dealing with
carpetbaggers for over a hundred years!" [turn tape over
622]

53. Dunar  . . . this operation.  I talked to Carl yesterday afternoon and he talked a good bit about the relationship of Crystal City and about the reevaluation and where does that really leave the centers both Johnson and Marshall in terms of what they can do right now?

54. Holt  It's probably at the most frustrating.  What it is is the program is spending about 3 million dollars a day on the prime contracts and all the contracted effort in the program.  We're not under any authorization to stop the work.

55. Dunar  That's one and then the contractor has to . . . ?

56. Holt  Yes.  The contractor's getting paid and there's awards fees riding on it.  So the evaluation criteria are still out there to be met so when you know that you're going to get paid on that, you have to work on it.  Point of fact though, we have put the contractors under severe limitations.  We were told to knock down all the overtime some time ago.  Golden directed that we to kill all the overtime.  The net effect of that in a design contractor especially McDonnell Douglas and I also think Rocketdyne and probably to a lesser extent Boeing just because of the schedule.  McDonnell Douglas had an awful lot of, the truss design is a very complicated design.  It looks like it's

fairly standard and regular and everything but the beams in there are actually tailored to carry loads to be able to get out weight. So you have an optimized design and it's kind of grown from a standpoint of we want this box at that location and it's going to weight about this based on the estimates we've gotten and some of these estimates are matured and some of them are not. Then you take the structural margins and you go design secondary structure around that, route all the wires where you want them pinned and that whole business. By the time you're through with that and you've got every single device in there and then you've gone through and figured out what the stresses are for launch, what would you do, can it survive a landing in a shuttle. So you have all the design considerations as well as the considerations on orbit. The thermal stresses and strains for thirty years so the life cycle of the program. That's an extremely labor intensive design. You use KTM systems so making the changes to the KTM system are fairly good, easy. Being able to look at the design, picture the design in 3-D, be able to skin the onion, you know peel back the layers of design, the ked systems are incredibly good but at the same time they still require the analysis to have occurred to be able to say that this beam this big goes there and these kind of dimensions. So the Ked system really eliminates a lot of the painstaking draftsmen's errors because it has automatic scaling and it has automatic notes and it prompts and it won't let you do certain things.

It really eliminates a step to the draftsman and back to the
draftsman and back to the draftsman, that type thing.  Now
it's to the checkers and the checkers say, "We don't do that
to McDonnell Douglas or Rocketdyne or Boeing.  You will go
back and or prove to me that that works."  It's that type of
thing now.  It's the same management check that has already
been in existence.  But the skill level of the guys who
operated the machines are engineers in almost all cases and
there's a good young population.  The average age on those,
you know the whole space program has fallen into a two hump
curve.  The old guys and the new guys.  Well the new guys
are running the machines.  The new guys have young families,
and the new guys are surfers from California, and they are
working.  A lot of them were contract hires, and the were
working a lot of overtime to get this thing out, and they
were getting paid the overtime at their grade levels and all
that.  That then allowed them to take a $40,000 salary and
bump it to $70,000.  I mean they were making some money.
Some of these guys were working 80 hour weeks.  60 hour
weeks were about the norm.  When you go to a no-overtime
policy, and literally and not only that we had the inspector
general monitoring and spot checking and that's criminal
penalties can be imposed if you find out.  We had been only
able to go in and for our CDR packages to meet those
commitments we were allowed 130,000 hours of overtime for
example.  So we've been able to on the spot, very very spot
things.  It got down to the point of having to ask for

$22,000 to support a test over here.  We had to have the
administrator's approval for $22,000 dollars in a
$15,000,000,000 so the frustration level is extremely high.
I think that's probably, it's obvious that they want to slow
roll the baseline program and let the new program catch up.
They've introduced, we know right now with the budget
targets that it will take another year.  We're a year out
from what we're looking on.

57. Dunar  Does it at this point look like you will be able
to mesh the baseline program with the redesign?

58. Holt  Yes to a great degree.  What happens though, when
you start taking out fit segments and repackaging a lot of
gear, then the idea of taking up the laboratory first and
then attaching it before you attach the node, you end up
with, all the low pads changes back into the primary
structure on the truss.  The guys that are doing most of
this redesign they were trying to save the money for
integrating the node because this is the difference between
because most of that is Marshall dollars, it's $30,000,000
to preintegrated this node and put all his hardware in there
so therefore if we just did that in a lab and launched a lab
first, we could save $30,000,000 on node integration.  But
we're going to send a $100,000,000 relaying out the truss.
But it's the kind of thing where the guys that don't do that
for a living make the assumption that they see the computer

programs and they say well all you have to do is tell the
computer I want to move it over here . . . .

59. Dunar  And it looks good on paper!

60. Holt  Yes, and it looks good on paper!  It's the kind of
thing that says, well it's just like stacking a [697?]  I
mean all you do is just move all the boxes in there.  The
answer is [699?] have to get the heavy stuff on the back.
That is really something that is not in anybody's experience
base so everybody is operating right outside their
experience base in terms that the real difference is the
fact that it comes together in stages.  Nobody had ever done
a development program to where you didn't at least have an
end item.  When we went away from this stick and ball
approach and the truss members and everybody, the sales
pitch on that back when it was being done originally was
that was done because you knew it was cheaper than not do
all the ground systems verification of having preintegrated
all the truss work but they were still thinking about the
big truss whether it would look a lot like that versus just
putting it all together on orbit and then assuming it was
going to work.  So the answer to that came back, and this
was back in '85-'86 time frame, says, yes there isn't any
additional overhead and penalty to hook them up that way.
We examined that after we had finally decided that the risk
of putting it together was that you could not stand the

interruptibility there that you couldn't guarantee that at

any point in time you could stop, disconnect, and bring the

Shuttle home in case of an emergency.  That was the thing,

and you couldn't predict the number of flights very well.

In fact what you were having to do was you were having to

work on just how much the mass the orbitor would carry to

orbit.  It was very difficult to then get back to a thing

that says we'll have to have this, this, and this there at

this time, these functions have to be accurate.  Now, how do

I package all that and then anything that didn't fit it was

"Oh damn, now I've got to start all over again."  It's the

difference between doing a custom build on a lot and hauling

out some double wides and sticking them together, adding on

a porch and a few of those things.  Literally, it is that

way.  It's hard to go do a custom build because you've got

to figure out where you're going to start.  The architecture

job was tough, I mean really tough.  We knew what we wanted

it to look like at the end.  We knew what we wanted it to

look like at a couple of stopping points, but you couldn't

get the first two or three steps to look pretty.  Really, we

were struggling like hell with what function now do we have

and the fact that we were coming together single string.

Any single failure could really put you in a bind and if the

orbiter left, we weren't sure how we'd go back and complete

it.  So we were starting to run the risk on the numbers of

launches getting out of hand.  That was always a concern

that the agency had that says "hey, if you can't nail down

the number of launches, it's tough for me to believe that this thing is coming together." We were under some fairly stringent commitments from Congress that said you have to operational on the sixth launch. Well, Congress ought to never to you that you have to be operational on a launch in that kind of thing but what it forced out quite frankly is the thing that says this design won't support that milestone. I mean that was the real requirement that was coming out of the Congressional staff and it was. I mean they were hardnosed about it and they were pushing for utilization. They didn't want everybody to fall in love with building it.

61. Dunar  The relationship between the agency and the Congressional committees, is it close enough that the people in the committees understand what all this imperatives are?

62. Holt  Oh yes. Well in that case of restructure, if you take a look, we actually took, Dick Mallow and Kevin Kelly's guidelines and went right down the list that says you can't spend more than $2 billion dollars a year, or $2.1, and you have to be there on fight early utilization, and we'd like that as early as possible. We had a lot of push, Bill Orr wanted us to be up there on five, the fifth flight, and we convinced him that there was just too much risk and the best solution was flight seven, but you could make flight six. He went with six and he had to be convinced. I mean it was

a fairly raucused meeting.  I mean it was down to the thing that says "you bastards are sand-bagging me."  They trotted out all the detail and analysis that we had and convinced him finally that OK.  Our big concern at that time was that if we did that, and I don't know how they were getting around this option, but if you put up the lab up first in that scenario, then you cut down some margin.  The one thing about having a node is you can attach on different sides.  If you put the lab there, you've got one port that works now and things have to come around that one port.  There you're back to a question of do you build to an end item?  Do you build with some flexibility in there?  This was JSC design capability.

63. Dunar  Now there was a cutback in the number of nodes as I understand.

64. Holt  Yes, it cut the whole module pattern back.  The module pattern, the labs and the habs were chopped back from full length of the bay, 40 or whatever feet, cut back to about 27.5, so it chopped them in half.  Then you went to a Lab A, Hab A, and Lab B and Hab B and you're going to have two more nodes so you would have had a module pattern.  That literally was, they were not funded.  I mean we kept them in the contracts but there wasn't any money put against them and they were delivered post-the year 2000.  Literally, what they were there for was to preserve an option for the

contractor so I didn't have to go recompete.  Then Marshall
did the same thing with Boeing.  They never had money
against them in any of the submits that we did, and they
were uncostly but they preserved contractors.  What you were
trying to preserve in the original design was a racetrack
pattern with the station and this would work out over time.
The original, if you wanted a node, here's the way we had it
set up.  (he's drawing)  You had the international partners,
[778?] and then you had a node.  What you were trying to do,
this is a lab and this was hab, in a racetrack pattern says
that any time I get in trouble, I can close these two
hatches.  I'm isolated.  So if I lost pressure here, then if
that hatch won't seal when I try to close these two hatches,
if they won't seal then I'm on the wrong side cause they're
pressure assisted.  So if I call roll in the hab, try to
close this hatch and the hatch pops off the seal everybody
get on the other side, and we'll close it from that side.
Now we're safe.  It's that type of deal and that was
something we working out early on, did a set of contingency
optionarios between ourselves and Marshall and the [790?]
guys and came up with about 13 conditions that we ought to
protect for one side or the other.  Then you ought to have
enough provisions in here to where you have water and enough
time.  You always worry about the fact that if you have the
shuttle here and you were one the wrong side, you know you
had to go do something so you had an airlock so you could go
back around if you had to.  Or you had and A-serve.  You had

so much equipment that you just, everybody had something for
every situation and then over time it's gotten down to a
thing that says well you just won't have all that.  It's
nice but . . . .  So when we got around to restructure we
went from this approach down to a node here, (drawing again)
lab that hung off the truss, and hab and then put
international partners on this side.  Then we were going to
run lab and hab A and B with two nodes in there and then run
hab and lab A and B off this end.  That was the growth
station there.  This was not contracted.  It was in the
contract but it was never funded.

65. Dunar  Does that still preserve the safety?

66. Holt  Yes, that gave you this.

67. Dunar  I see.

68. Holt  It ways when you get to PMC, if you want to go
back and put you're racetrack in because you're always
worried about getting hung up in one of these blind allies
and you spend a lot of time and effort on what kind of
[808?] compretion and those kinds of deals.  In typical
fashion we just beat the crap out of them.  We've had the
arguments and twenty thousand opinions and steeled them down
to the good arguments and the good arguments with the
Japanese and the Europeans are somewhat different.  The

Europeans have always, are extremely pragmatic for one thing. They no longer feel like they're a little brother. They're full partners and they considered, and they're just as arrogant as we are. The Japanese are literally just kind of taking notes. They've got good engineering talent. They really do. Mitsubishi has a fine team, and they're kind of slim, but they kind of watch to see what kind of deals we cut with the Europeans and do a few "me toos" on those and the one where they really don't like them they'll drag their feet until hell freezes over and make you work. That's been kind of interesting. The laboratory, the elements most of that negotiations, the systems negotiations with the Europeans and the Japanese and the Canadians were pretty much done from here with the exception with some of the standards on racks and how they were to be mounted. Those were all done through Marshall because Marshall, they are the rack, how racks ought to look in the program and what accommodations get made over in the European and Japanese racks for interchangeability between the US and the European and Japanese cure. Those activities have been run through by George Hopson's office. Every so often we run afoul of them because they get off and cut some deals on DMS segments and then "George, I don't think we can make that one. Not exactly what we had in mind."

69. Dunar  I'm wondering about the redesign too with the Europeans and the Japanese how they, I'm sure they're angry, but how they're reacted in terms of . . . .

70. Holt  Oh they're totally ticked.  I think it's more than, they've dumped a bunch of bucks in this thing.  They all have funding pressures.  A lot of their's is posture, but they've all got the same funding pressure we do.  In fact, the Europeans are working a 25% cut on their program. They were sailing along, the same thing happened to them as happened to us.  When the wall came down, the Europeans, the Germans who were 38% of the program, all of a sudden had to bail out East Germany, and space isn't a real big ticket over there right now.  The year the Germans start pulling out the French are not going to fund the whole thing and as I said, the Italians can't.  So they're now into a fairly large cut.  Every time we give schedule relief, they sigh. They're happy to see it.  Although the guys working on it don't like it, but in terms of the governments over there, I don't think their governments are really that upset about it.  What they don't like is they don't like to see us work with the Russians.  Official statements that they've made are things that say that, "we've got a partnership as far as the station freedom program.  We want to be in the room when you guys are doing all the deals with the Russians," and that's not happening.  The merger of the programs, the US is off working its deals with the Russians, and they're fearing

that they're going to be cut out or have to go scramble
around for pieces.  The Japanese I think have been, you know
you pick up all kinds of rumor, but I think the Japanese
have been having extensive lobbying activities to try to
lobby the administration to get something going on a
basement program.  There is a lot of high level politics
going on in this thing.  This thing was born in politics and
it's going to play its thing out on that stage.  When you go
back to the dual keel station with all its accommodations
and everything, there was something there for everybody and
literally there was no way, you couldn't have afforded it
and you probably couldn't have put it all together.  It was
the camel built by committee, the horse built by committee.
As it's just been cut back little piece by little piece down
to something that can be afforded, what's happened is we've
taken chunks out of the development program, but we've left
the middle round programmatics and not cut down the
dimensions of the size of the program.  We've left an awful
lot of people laying around on this thing.  We've gotten it
down now to where the program itself is not big enough
literally to support the numbers of people who want to
manage it.  In this conversation we just had there, we're
slow rolling everything in order to support the design
activities out at Crystal City to make sure that we're not
being irresponsible on contract management period.  Very
clearly then the impetus on making the change and we've done
that before.  We've had people who worked the baseline

program right up to the point in time when the contract
direction came down and says this is the program, move out.
When we went out of the preintegrated truss activity that
we've done out here, we had a lot of things that we had to
go sort out.  We had done a good job working with
Rocketdyne, McDonnell Douglas, Boeing.  So Marshall and
Lewis were involved.  We had the NASA centers pretty well
wired together.  What we didn't have was the international
partners absolutely did not participate.  I spent the next
year hammering out agreements with the Canadians.  We spent
a lot of time hammering out, Cathy Cramer who was one of my
office managers here, hammered out a lot of the node
agreements between Marshall and the international partners
at JSC because we were trying to screw together the
international interfaces so we made a lot of changes.  Not
as significant, but they were starting to threaten our
schedule.  We needed them to make sure we had the node
nailed down.

71. Dunar  Now the design that you have here does not
incorporate any roll for the Russians.

72. Holt  No, not really.  Other than the Soyuz for the ACRV
and the Docking System.

73. Dunar  So that's the provision you've made essentially?

74. Holt  Yes, in the baseline program.  Where we're headed, the docking systems that the Russians used are the same ones that we used in ASTV.  That was a JSC design.  The only difference is they had gotten 15 years worth of use out of that thing now, 17 actually.  So they've gotten 17 years worth of operational experience in small improvements they've made in the system.  That was one of the things Truly negotiated with them before he left was to buy one of the systems back from them, so that was kind of the opening of the doors back in that time frame.  A lot of the concepts that have been around, we started seeing concepts back when we did a set of blue-teams, red-teams last summer.  I don't know if anybody has talked to you about that or not.

75. Dunar  No.

76. Holt  When Golden came in, he instituted a blue-team, red-team.  Blue-team being the existing program, what can you do to meet cost targets and change your design and a red-team that was supposed to be a non-advocate team that would have gone in and taken you apart.  It didn't quite work the way it does in industry.  In industry, non-advocate teams really come in and do take you apart on a proposal.  The red-team, blue-team kind of went back to Golden handing [927?] with a thing that says this is the right program.  While we were up at Restin going through the blue-team, I was the project blue-team rep, we saw an awful lot of things

that looked kind of flaky.  Kind of like the Space Station

Freedom with a mirror shoved up its rear end.  That type of

thing.  Then it's kind of like "Well that's interesting, but

how in the hell would you ever do that."  That was the first

exposure that most of us had to a thing that says the

Russians are coming.  All of a sudden we're talking about

what kind of inclinations can we get to.

77. Dunar  That inclination is coming strictly from

Washington?

78. Holt  Yes.  The inclination started with a thing that

says how do you use Russians assets.  Performance losses on

the Shuttle are dramatic to get to 51-6  and glues around

12.5 thousand pounds at launch.  That's about 30% of

capacity of the launch mass that you can have of your launch

up weight.  In terms of the design that we have, we can't

launch anything without completely repackaging the whole

deal to that latitude, inclination.  So we look at

compromises and it turns out that the crossover points are

around 33 or whatever for the shuttle and the [946?].  So

that's why you hear, Aviation Week had a pretty good article

last version on the different inclinations and different

traits and that's kind of what they're all about.  There had

been a lot of, every time we get into a thing that says you

could launch what you've gotten on a launch vehicle, well we

design this thing to take the loads in the shuttle, to take

the loads in the trunnions at different places and to handle
landing loads as well.  The launch environment on the
Russian vehicle is not known that well but what we do know
of it is it's a much harsher environment than what we're
designed to.  Shuttle actually is a pretty benign launch
environment if the max you pull any time is 3 Gs.  It's
pretty easy on the crew and equipment.  Most unmanned
vehicles have higher accelerations, considerably.  So we
couldn't take what we've got and stick it on there and
launch it this way without a significant amount of redesign.
Every time you start out, it says the baseline program
doesn't fit well with trying to fly at higher inclinations.
Higher inclinations has a lot of benefit.  If you'll go
look, we flew Skylab in 57, originally it was 57, and then
the bottom line on the positive benefit of 57 was really
just the amount of Earth you fly over.  You fly over that
much more of the planet and you get into the higher parts of
the atmosphere.  We added some packages late in the program,
in fact the last two years to do are resources are looking
at spectrometers and so forth.  [interruption and joke about
contractors trying to tell him how not ready they are] It's
easy to look at the thing and say there are a lot of reasons
to fly a different space station.  It's hard to look at it
from a standpoint of when you get this close to that design
and you've been to CDR and you know that you're getting
ready to build it and you suspect that you're getting ready
to put an awful lot of US industry workers out of work and

to pay those jobs and to keep the Russians going, it's tough
to buy in to that.  The national agenda is usually something
that they don't ask you to comment on, work for the civil
servants.  You just have to work on what they tell you to
work on.  That's the bottom line.  It's not any easier for
the guys in Huntsville than it is for the guys at JSC.
There's an awful lot of guys over there working the baseline
program who are just as nervous about what Charlie Darwin's
guys came up with.  Charlie runs a proposal factory and he'd
self-contained and quite frankly he's the best proposal
factory in the agency.  There's no question about it in
terms of being able to respond quickly with a credible
proposal that's something that you could do and bound to
cost, bound in engineering perimeters, they've got the best
capabilities in the Agency.  They'll do them on any scale.
The risk to that is that when you scribe the same level of
material to a study that you do to a design, then you have
really and that's been I think the thing that has been the
hardest for most of us to accept that the design was
impounded along the way somewhat needlessly quite frankly.
The business that we're limping through CDR, we are not
limping through CDR.  McDonnell Douglas is sandadizing the
bulkhead for the first one and got lay-out drawings out the
ears.  When you take a look at the total number of drawings
required for use for that thing all out through PNC, there's
a ton of stuff when you look at what's got to be there for
CER and smaller fractions.  We had an Air Force team as part

they're not intending to go off and add to the SCS

compliment to a great degree with this program.  In fact

they're going to bust it back and get it back to a normal

alignment.  Restin was way over integrated than any place

else where SCS is at levels that with any other program or

any other center are just not the same.  There were some 20

odd SCS in the program which is very high when compared to,

it's probably equivalent to Shuttle.  Shuttle is a monstrous

program over three centers and headquarters.  They way they

went about staffing Restin is they ended up with an

inexperienced staff.  They had the grade and they all got

promotions for going up there and I know that at JSC it led

the Level B organization, there were 40 people that left and

the average, if you just assume that the average years when

they got out because they all took early outs was 25 years,

you just dumped 1000 man years out of a program and you

replaced it with guys at the 10 or 15 year point.  You gave

them the rank but they didn't have the experience and you

didn't have a team.  I mean you had to bring people up from

Marshall and you got some in from JSC and you got a few down

from Langley so all of a sudden you had a multi-cultural

experience going on and you've got guys out of the Air Force

and you've got them out of a Navy.  It takes time to blend a

team like that.  Then we had Program Directors and Program

Managers turn it over so until we finished restructure and

Moorehead, for all his, in terms of let's just say Bob's ego

could usually fill a room, but we knew that when they named

Moorehead that one thing that would happen was that Restin
would either succeed for fail.   There couldn't be a middle
ground and most of us that had worked with Bob knew that
that was going to be the case and that's been the case.   He
rode it to the last gasp and it didn't make, but it had its
best chance of working with Moorehead.

81. Dunar  Did it have a lot of things against it from the
beginning?

82. Holt  Yes, if Tanner and Odom had of stayed I think it
would have worked because you had the guy who, Tanner was a
hammer.   Ray was really hardnosed.   He'd been chief engineer
on Spacelab.   He knew what he was doing and we knew he knew
he was doing.   We knew where the arguments were going to be
and we knew where the lines were going to be drawn.   You
couldn't waltz a story up there.   You had to have something
that focused the issues, you had to recognize the issues.
The Agency has never allowed shallow stories like that.
Marshall doesn't and JSC doesn't.   If you can't put a real
story on it, hell they'll throw you out of the meeting and
be unceremonious about throwing you out.   It's always been a
tough competitive environment for the best technical
solution and the best technical solution sometimes is
costly.  It's not like Apollo.   Apollo, if you talk to Bob
[137?] and guys that worked back in the command module days
and those times, to a great degree faced with a thing that

says we've got three technologies because Apollo was kind of operating from the seat of the pants, and we're not sure which ones are go.  This is the one where we think is the right answer.  The Program had enough money to carry all three options and make a decision downstream that says bring me some test results.  Well, we're doing a ton of analysis and a lot less testing so you tend to be conservative when you do analysis and you can't destruction test something and say we'll I know where it breaks and I'm not worried about that any more.  That same time problem with the Shuttle. We'd done an awful lot of bianalysis there as well. Analysis techniques are excellent and people have gotten extremely smart and we've run a lot of cray.  We have had at one time seven crays working on that truss design out there. We had to go, we bought time at University of San Diego.  We bought time in corporate resets and assets.  Anybody that has a cray around, everybody was trying to find the time because the programs, these big stressed and strained program are monsters.  So there's a level of sophistication on the analysis that's behind the design is really transparent to all those that aren't working on the design itself.  The numbers and cycles for 30 years, well that says, "If you want to get an answer in a hurry, you better run it.  You better get you something big."  The other side of it is that the technology naturally likes to creep.  They guy that says "I built a great big program, I want a big answer, I want a cray."  And cray time is expensive and the

guys who know how to put it on crays and can interpret the
results get paid pretty well.  So you don't have too many
$15.00 an hour draftsmen working on this program anywhere.
Of course, God any government program the loaded rate is two
times what the hourly rate is so you are automatically
paying prime providing the base capability for the primes.
You're loaded in favor of spending a lot of money.  You cut
back, if you take something out of the design you don't save
much.  You save a few hours of labor, but until you get into
the base of a contract you don't save much money.  People
really don't understand that.  Until you take off the
numbers of bodies working on something and reduce the amount
of taxes that you're paying whether its to a base
corporation or to a center, then you just don't save any
money.  And the government works the same way.  If they're
850 people working on the space station at JSC then the
program is taxed for some percentage of the salary and the
support at JSC to back those up.  So you are always
struggling to, I mean you want to dig as much money as you
can out of the program's pocket, and then you struggle like
hell to get the amount of hours back on your engineering
organization.  Then that's where you get into, what I think
from that standpoint it is easier for Marshall to make the,
to do this than it is for JSC, the chief engineer on.  I
mean when he picks up the phone and calls, he's got a
hammer.  I can walk into the next door office to the lab

director at the S&E labs and say "I am not getting support

from him."

83. Dunar  Probably too is there's, it would be a lot easier
you mentioned in developing software, I can see that there
would be an awful lot of potential for growth there more so
than developing hardware because you can define the hardware
and there's not too much [230?] to do there, but in software
it could . . .

84. Holt  Oh yes it grows like crazy.  You know it's going
to grow.  Right now the biggest single argument left in the
design is over the data management system.  It's over the
level of testing, and it's over how flexible the software
is, how much of it is in E prompts, what your imbedded data
processors that it's burned in versus how much you can
actually make it do something.

85. Dunar  Is there still a debate going on . . . ?

86. Holt  Yes, even [end stop tape] [change to part 2]  I
think in the data management system, it's an extremely
strained relationship right now between JSC and Marshall
because the date management system has been the JSC
deliverable and one of our systems that we designed and
delivered.  Right now, the simplified approach that came
back for option A is a proposal that has been rejected some

time ago but that Marshall has continued to champion.  Right
now in the transition negotiations, JSC has looked at votes
and has really been very very, our guys don't like and it's
gone back with all the reasons why they don't like it.  Now
we're expecting then, in the redesign and transition team
activities, to have that activity sent back down here for
evaluation and have Marshall come over and have meetings.
The way it worked out is our guys went over there.  It
literally is down to the point in time to where the
transition team feels that JSC will not take this approach
seriously unless it is done on Marshall turf.

87. Dunar  Really?

M:  Yes, it's pretty straight forward that way.  There's a
lot of dynamics like that goes on.  You've got to remember
it's not like the Air Force where people move every two
years.  I mean we grew up with guys, and we work with them
and argue with them over the years so we know where they're
coming from.  We've hammered out requirements all the way
back to the mid-80s here for ten years over how you ought to
do it, and they've never liked our approach, the JSC
approach.  There are parts of it that I personally don't
like.  It carries some risk.

88. Dunar  There's enough difference between two that
they're just irreconcilable then.

89. Holt  Yes.  Irreconcilable.  It is down to the thing that says either you go all the way with one of them or the other.  We're into that.  I mean you really get down to the real high stakes poker game now.

90. Dunar  Well I can see especially with data management because that was probably more than any other system this is more intrusive because the interface is so tight.

91. Holt  Well, the whole system is operated by computers.  Your switch is on the space station.  This whole thing is not operated like anything we've ever done before.  In the shuttle we used a computer to operate the flight critical functions, guidance, navigation, control, and displays.  If you want to turn on an APU, there's a switch and some meters.  We don't have that.  In fact we've even argued over emergency stop switches for the mole transporter carrying the arm down the track and had some real knock down drag outs.  The crew in the astronaut office has always demanded design changes and has always argued vociferously as part of the design team.  I think probably the one thing, you can't ignore the operator, and in NASA it's always been pretty much something that says you have to satisfy the crew and they have to have their day in court.

92. Dunar  That's been one of the main arguments all the way back to Apollo between JSC and Marshall and accusations that Marshall was ignoring . . . .

93. Holt  Yes, there's been some real knock down drag outs. Even, well even Shuttle C.  I worked on the evaluation of Shuttle C, and Marshall had some state contracts.  It was very obvious that Marshall wanted all of Shuttle C without any, they didn't want to mess around with anything JSC. What they had done was they had assumed that they would use different computers than was in the shuttle.

94. Dunar  As a way to shut out JSC?

95. Holt  Yes as a way to keep JSC out of it.  The only thing that kept getting back in their ear, was they kept getting it from KSC that says "we have to redesign the launch processing system.  Here's our cost."  Well they didn't want to hear that.  Well then here's the OPS guys at JSC with control centers and things like that and here's the cost per trainers and all the other things and such. Unfortunately I think on things like Shuttle C we had to compete them as new starts.  We made some errors.  Marshall came down with the Shuttle C, and they came back and they had a launch vehicle.  Truly sent them down to JSC to get an OPS concept and when it came back out of here, it had the OMV stuck in the nose of it, Orbiting Maneuvering Vehicle.

Now TRW contract was in trouble, and Marshall was
overrunning the hell out of this contract so they were
trying to tie it to anything.  The problem is when you take
two vehicles, you didn't need it was number one.  All you
really need to do on Shuttle C was remove the crew cabin and
then use the control system since the jets are in the nose
and the jets are back here.  Well when they took out the
crew cabin out and put this guy in, all of a sudden you've
created an integration nightmare.  Now you've got a control
system, and they wanted to be able to fly this up and dock
it to the Space Station.  Great OPS concept.  Very expensive
OPS concept.  So it just blew this whole thing out of the
water.  Had you gone in and incrementally just said "this is
just kind of an enhancement program and we want to just see
what we can do."  For a small amount of money you probably
could have gone off and just continued to build and got you
one and not done a crew cabin and just build a shell of an
orbitor.  Taking anything apart and modifying, pulling an
TRW OMV which was poorly defined and adding it to an S, all
you were doing there was you were just inviting yourself to
contract disaster.  We were getting ready to make another
mess out of this thing.  All JSC/Marshall collaborations
don't mean success stories.  In my opinion on that one, the
combination of the administrator wanting to make sure that
he had something that was going to work, and I guess at the
time Dick was AA for OSF when he first started all that, and
it just finally, he couldn't support it for a new start.

New starts are tough.  You go back in the very early days of
Station back in the 70s, Marshall wanted to creep up on it.
They wanted the power extension pallet.

96. Dunar  [?083]

97. Holt  Yes and it always has been.  The bottom line is
Marshall is extremely pragmatic.  They always have been.
JSC has always probably lived on the Apollo euphoria and
Shuttle.  We got away with the overruns on Shuttle and
people liked the vehicle, and Marshall having undergone the
death sentence over there and surviving is down to a thing
that says don't push it.  Go what you can.  Do it with as
little fanfare as possible, and just make continuous
improvements.  I would really say that that is a marked
contrast.  If there's anything that really contrasted the
space station development ideas of Marshall and JSC is the
last guy that showed the great big grandiose space station
out at Marshall was Von Braun.  I've got the 1957 Life
Magazine that shows Von Braun holding the space station with
the big circular wheel that was going to rotate with the
artificial gravity.  That's probably true.

98. Dunar  That's a good way of looking at it.  That makes a
lot of sense.

99. Holt   Kraft was into solar powered satellites and space operations centers.   The dual keel, what came out of skunk works really is that idea that says we want to go out with the biggest thrust we can get.   JSC has always been expansive in terms of [103?] to the national agenda and build it into an empire, and Marshall I think has always been hesitant and says that's not realistic.

100. Dunar   One of the really interesting periods, I've been working on this developing of Space Station thing, in '69 and '70 when they were debating between Shuttle and Station. At that time even when it looked like funding was going to be a little short and when it was looking more and more like they were going to have to make a choice between them, they were still talking about a fifty to a hundred manned space base.   So this idea of this grandiose program even when the funding constraints were clearly going to be a problem.

101. Holt   We had a division down here.   We had a division at JSC that was working on Space Station.   Max Faget had a division.   Probably had 60 people.   Maybe 40 or 60 something like that.   That was a lot of people back in those days. Marshall was doing concepts and studies with contracts in the early 60s.

102. Dunar   Could you, I don't know if you can really do this, but in laymen's terms tell me the difference between

the data management approach that Johnson has and Marshall
has on station?

103. Holt  The real difference is, the data management
system, just let me kind of draw you a little picture.
Maybe that will help.  The data management system is a
question is how computers are in this system versus data
processors.  How much central processing you do versus how
much you do in distributive processing.  It's that simple.
In its simplest form, you've got a data processor which is a
computer, it's an IBM something or other, actually its a 386
chip.  That then interfaces to a set of MDMs built by
Honeywell.  MDMs are somewhat, we're getting sophisticated
now.  They've got cards, and they've got actual memory in
the MDMs, and they take a load.  Then they're processed out
to the devices.  (he's drawing again) These are cards and
then those cards are communicated through devices and [?133]
back to here.  Then the question of how much do I allow at
the device level with an imbedded data processor which is a
chip.  How smart is the device?  So how much is the MDM just
routing data back and the smarts are out here versus the
smarts being either here or here.

104. Dunar  So its distributed in other words means that
you're farming more of the out to the elements?

105. Holt  Right.  If I'm in the Marshall approach, they want to take the computer out of this and just have a controller in the MDM up here because the MDM has computational power, but literally they want data routing and then they want it totally decentralized that says "OK the GNC systems over here doesn't really have to talked to contract system over here."  In the JSC approach, we had our alpha joints, rotary joints, moving to track the sun and beta joints moving to move the radiators around to get an optimal mix on the temperature radiation as you flew over. Then we were doing computations, and there was a lot of cross communications and coordinations between the various systems.  The Marshall approach is less of that and more of a "well, don't optimize."  Does that sound right?

106. Dunar  Yes, I know what you mean.

107. Holt  Philosophically, "don't optimize" in Huntsville and "optimize" in JSC is probably another one of those fundamentals.  Then here, I think the one thing that people are missing, and this is one of the things that separates JSC from Marshall in this approach is the idea that the Station comes together in stages.  This kind of approach has trouble with that.

108. Dunar  The JSC approach?

109. Holt   No the Marshall approach because it's trying to

set an end item approach, but where's the end item?   It's

find for a lab that all comes up here at once.   It's tough

for MV-1 which doesn't have CMGs on it and is a passive

vehicle power system.   The MV-2 which is where I finally get

a computer outside and has attitude control, can reboost it

by [?166], has control capabilities.   The MV-3 now has the

arm.   The mass properties change that the control system has

to compensate for all of that.   The reboost would be

different in all these considerations.   So with having the

computer then you have . . . .


110. Dunar   That can all be taken into a data base . . . ?


111. Holt   Yes, you have a data base as you channelize.
This says I'll rechannelize every time, and I'm adding MDMs
every time I do this.


112. Dunar   So the Marshall approach, by the time you get to
the third or forth fight and incorporate that you're first
unit is almost obsolete?


113. Holt   Right.   It almost looks like the thing that says
if I start from a buildup approach then this architecture
has more flexibility in it and allows you to make change.
If I start and look at it at the end item approach which is
when the lab's hanging on here and the truss is already

built, then I tend to want to go and lock up more stuff.  I
think in this case you'll find out that for the assumptions
that Marshall made, then their design is fine, but for the
assumption that we made that says that you can't put it
together that way very easily and accommodate all the
changes you need to make, then that's how JSC has ended up
with the approach it's had.

114. Dunar  The JSC approach is probably more adaptable for
political changes that are forced on the program too?

115. Holt  Well I don't know about that.  I don't anything
can accommodate that!  I don't think any computer can work
on that!  It doesn't make any difference wether Honeywell
built it or IBM but it literally one of the real tough
problems that we faced in shuttle that has not been a
problem in Spacelab is the flight-to-flight reconfiguration
and having the software then.  Since software handles a lot
processing for the payloads back in the bay, we do a
tremendous amount of rechanneling back and forth.  LSAT
doesn't look like TDRS or Spacelab or whatever.  The changes
that you make on a flight-to-flight basis then, that amount
of reconfiguration and testing that we do on the shuttle is
something that Marshall doesn't have the experience base
with Spacelab because the Spacelabs are tailored.

116. Dunar  Spacelab, the data management still came from Shuttle right?

117. Holt  Well it's got its own computers, but Shuttle is in interface to it and it is piped to the ground.  There's only a few primaries that cross over into the Shuttle system and that's for safety monitoring.  So it's an independent system, and they're butt-welded to each other.  That's kind of what you've got.  You've got a thing that says Spacelab worked this way.  And the main engine controller works this way because it's roughly independent.  It's processing like crazy to keep the engines running at the right mixture and all it cares from the computer is whether or not I'm still flying or not or whether I need to shut down.  All of the Shuttle examples that Marshall draws on, they don't face the reconfiguration problem.

118. Dunar  Only as much as their looking in Spacelab I suppose.

119. Holt  But everyone of them is built unique.  You don't fly.  When they take the Spacelab down, they're flying them about one a year, so you take everything out . . . . .

120. Dunar  Which they do for the experiments anyway.

121. Holt  Right, so you take all the experiments out and you put them all back in and then you tailor everything. You tailor the thermal system, the air distribution.  You just have to rebuild them on a flight to flight basis.

122. Dunar  So you might as well do it with a data management too.

123. Holt  Right.  With the Shuttle, then the data management system here is part of the five computers in the baseline so a lot of that data then flows into, you process some data then you also have the data that goes to the ground through the payload data systems.

124. Dunar  Would it be accurate then to say that both Marshall and JSC . . . ?

125. Holt  They're operating out of their experience base.

126. Dunar  From Shuttle and Spacelab?

127. Holt  Yes.  Marshall takes its experience base off the main engine controller and Spacelab that says "hey, I just need access to the grounds systems so I can send this stuff down and I can control it fine."  Change is not something that they see as an ongoing process.  JSC is sitting over here with eight to ten flights in flow on the shuttle and

every one of them has a different compliment and so it's

that type of, as an orbitor comes along, you reconfigure

every orbitor to fly the flight.  You can see that coming

from here that carrying payloads up and down, changing and

using an out and adding on major elements, has the thing

that says I need to be able to reconfigure this guy.  I'll

need a lot of data on the front end and later on I want to

collapse it down to where I'm not processing that much

information on the crew monitor.


128. Dunar  In a sense, I can see how you could make the

argument either way.


129. Holt  Yes, it depends on where you start.  If you start

with a thing that says this is the space station.  It looks

like this.  It's this big when it's put together, then

you're answer is what do you mean change track.  If you

start from a thing that says hey you've got to get there,

you've got to put it together, you've got to look at the

following things that are going to change.  That's the nuts

of the argument.  In terms of the intitial data management

system knowing that the assembly problem is out there,

knowing that they thing is going to change over time and JSC

had the system.  It fit the JSC experience base.  We

probably, on the JSC side, we probably overshot on the

thing.  When you ended up with an unbroken chain of JSC

avionics guys that run this program, Aldridge, Moorehead, I

think I read the list off to you yesterday, but what you ended up with then is now you have a culture that says not only do you have flexibility in a system, but you want to know every flight because if you change something and you don't understand what you changed, and it bites you, then you're ass is grass.  You're in front page of the paper just like last night in the Post where a guy sent the wrong center a couple of commands up there and they were outside of the envelope what they were doing.  They were doing some troubleshooting.  Anytime you have a thing that says "I don't know what's in the onboard computer," that's a sin in the space business.  Then I got a requirement for $300,000,000 worth of ground testing called the CAFCSF, Central Facility.  The first thing Ray Tanner did was he got on the programs.  He x'd that then Moorehead then put it back.  It is experienced based driven.  We talked this with Ray Tanner back in 1989 and Ray glazed over.  Literally just "flat didn't understand what you guys are talking about.  What in the hell are you talking about.  That's nuts!  I'm not paying for that.  Take it out.  This program can't afford that."  Bob Moorehead gets on and says, "How in the hell can I launch this thing without knowing what it's going to do?  How can you go in and tell me on a flight to flight basis, I'm flying a safe vehicle without this level of testing.  Put it back in!"  If anything does give you the flavor of the Marshall/JSC it is literally that everybody is a prisoner of their history and it's been interesting.

130. Dunar   That's an interesting case.

131. Holt   Yes, if anything really gives you a capsule view of the station it's been the, because the structure guys I mean they can all get together and agree.  They just finally have to see the day and they have to agree.  We had a bunch of issues at our CDR on fiber acoustics and the Marshall specs, Boeing specs and the specs we had on Mc Dac are different interpretations of the program spec.  Until we got to CER and we got three guys together to sit down and hammer out the thing.  No there were four:  two NASA, one Boeing, one Mc Dac.  We all sat down and said "Well, yes, this that, this that, this that, this that, OK.  We can handle this, you can handle that, and we'll go look at these."  Then it's over with.  Then all of a sudden thirty major issues collapsed at once, and it died the last week.  The program sees this as a thing that says, "Oh it's these major issues."  Literally the guys who work on it are down to a thing that says, "No, we got a culture and when we get to CER we'll sell it because the pressure will be there to have to get it down."

132. Dunar   So that's pretty common then to have these arguments going on in the CER.

133. Holt  Oh God yes.  The program is always looking to find the data at the very lowest level because it never trusts anybody that's filtering.  That is very much a JSC invention.  I'll draw this for you because you won't see this at Marshall.  The JSC invention says that you have engineering and you have the program office and you have the project office.  Engineering is the customer.  The project office is managing the contract down here (he's drawing).  This is the customer right here.  Then you have matrixed effort that goes off and interfaces with the contract and literally we expect these guys to interact with the contractor to a very great degree.  Marshall probably does not interact at that level with as many people as we tend to throw at the contract.  We tend to penetrate the contract.

134. Dunar  Marshall I think attempts to do that as well.

135. Holt  The contractors are probably a little more successful, well this may be a Mc Dac program because you couldn't penetrate Rockwell as well as you can Mc Dac.  Mc Dac culturally tries to please you everywhere.  Boeing is probably a little stronger business office flavor.  Mc Dac is having to put it in.  Corporately, Mc Dac is in big trouble.  It really is a corporate culture that says we try hard to please.  JSC has always done this.  Marshall does the same thing.  Now the difference is, if you take the shuttle program and any program unfortunately, the project

manager reports to the program director, but he's tied to
the center director.  He works here, and this guy works
here.  The program goes out and does two things:  they put
level of effort tasks on the contractor so they buy effort
on the contractor and then they put money on engineering.
Now what they've done is they have created a thing that
says, I've got your contractor and engineering telling on
you.

136. Dunar  To the program office?

137. Holt  Yes.  So now you've got an integration office,
system integration office or system engineering integration
office or whatever, and this guy, there's always a foot race
as to when something happens as to whether the project
manager can hear about it before these guys here about it.
Literally you're under constant barrage with a thing that
says, "You have all these issues and you're not working
them.  We know you're not working them because we've got
you're contractor down here and he's telling us, the guys
that work on our level of the test quarters, are telling us
that you haven't got a plan and engineering seconds that."
So you call up engineering and you call up the boss of the
guy who got this thing, and you call McDonnell Douglas and
you have a little session.   Then you come to a reasonable
meeting of the minds that says if it's this bad why in the
hell haven't I heard about it.  The answer usually comes

back as well that's kind of something somebody took and made some extrapolations and therefore dumped into the system and the answer is that well you realize now that you guys have a self inflicted wound.  You won't find that in Huntsville because when Marshall has their level 2 organization, first of all the project office is over here and serves as the chief apologist for the Marshall Space Flight Center. "We're sorry Bob we just can't do that on your schedule for that kind of money.  You need to send us some relief."  But, the chief engineer being over here, when the level 2 office showed up at Marshall, it was a level 2 office and here you have Frost as the Deputy Chief Engineer.  That's where all the effort goes.  Jim Bean had one or two guys up here and a nice office.  Frost didn't work for the chief engineer.  Now you come to JSC, these guys live on the forth floor, they don't even talk to Jack Vorkin.  They don't have to talk to engineering.  They've got their own task force and they've got their own organization.  They have a set of offices up there.  So it's a culture difference that says that engineering in Marshall is integrated within engineering . . . [426 tape out – turn it over and start with part III]

138. Dunar  . . . of JSC's lead center experience in the sense that you have the program office?

139. Holt  I think really its an outgrowth of, during Shuttle you just didn't have, you didn't want to do anything

else.  You weren't flying anything else.  You had the
program here.  You had the project manager here and Kraft
was Center Director.  I don't care who was in Washington,
Kraft ran JSC like Bill Lucas ran Marshall.  It didn't
matter where system integration got done.  If engineering
wanted to go off and do some stuff on their own, it was OK
because I've got them under control over here on the
orbitor, and I've got them under control over here on the
program.  But if the whole campus just up and did the job,
and that's been one of the, I suspect Marshall had the same
type thing.  Everybody went off and worked on shuttle.  It
didn't matter what kind of, who you worked for, you worked
on the program.  It was hard to say wether you were working
center or working program because there wasn't but one
program.  Then you had key people like John Yardley at
headquarters who then had to go corral Bill Lucas and Kris
Kraft and get J.R. to go talk to Thompson and Erin and
hammer.  He was the hammer and a very effective hammer.  He
was extremely concerned about the engine development
program.  He camped out on some really hot topics and set a
pretty mean pace for they guys who were having to work both
problems.  But at the same time, he gave them fundamental
organization.  He really didn't have to go sort out the
whole program, the problem, and everything else.  The pace
got set by a guy who could make it happen, and that's now
all bad either.  The same thing with Kraft.  We had a lot of
OPS guys out here.  We had a lot of program.  We had to

rebuild the center facilities for a lot of this stuff.  I
mean we retooled JSC while we were building this program.
It all got worked by the center director.  Marshall retooled
the center.  KSC retooled the center.  Literally, lead
center said that the program direction came from Bob
Thompson.  Those guys were tough.  They were good technical,
but in terms of the budgetary and everything, they didn't
have the purse string controls as strong as probably it had
evolved.

140. Dunar   That's what preserved Marshall's autonomy I
think too in that Marshall could play at both ends.  Sure
they were getting direction from Bob Thompson, but they
still went to Washington and go around them in a sense.

141. Holt   Well, Kohin had to do the same thing.  This
program, people have tried it. The thing that has gotten
Station in trouble a lot of times though, is that people
look at the shuttle cost perspective against what Station
might have cost, and they compare programmatic cost to
programmatic cost without realizing that there wasn't any
other program.  So the total agency commitment out at
Marshall and JSC and Kennedy worked on Shuttle.  There is a
disguised cost factor in what Shuttle development really
cost by the amount of the Civil Service Labor pool that
really went into that total. We tend to take a look at the
Station so you take the funds source one which is our RPM

source, our civil service, travel, and so forth.  I mean
that fund was applied to the program.  There wasn't anything
else to do.  I think we tend to forget that.  All the
facility development was done not totally on programmatic
funds.  A lot of it was done on construction facility
dollars.  It's just, I know a lot of the conversations I had
back when I first got started up doing the OPS stuff here, I
would take a look at the cost projections and we were under
attack from people saying well shuttle didn't cost this
much.  Answer was, "Like hell it didn't!  You've got to be
dreaming."  It's all a question of who's bookkeepers you
want to believe.

142. Dunar  It's pretty easy I think especially in
construction of facilities, that fund especially, with all
the test stands at Marshall especially with reconfiguring
them to use the Shuttle tests and all that.

143. Holt  Oh yes, tremendous amount of money and the
priorities you had to put on that stuff, you couldn't have
worked that except through the center directors.  The
business about lead center versus program change and
everything that is an old tired argument quite frankly.  I
think the agency has benefited over the years by having the
center directors make a lot of tough calls,  and we're down
to where center directors are going roads and commodes as
space commanders then that is going to be one hell of a

cultural change at the agency and the only way you'll do
that is to bring in a significant number of outsiders.  If
that's the intent then that's the only way they'll do it.
They'll have to run a bunch of us off who's spent twenty
some odd years doing it this way.  Generally, I mean you've
got a high profile administrator right now.  First time in a
long time.  Beggs was high profile, but it's not been the
norm over the years.  I think probably a high profile
administrator stays with it for eight to ten years so he can
make a lot of changes.  If he's a two-year phenomenon he can
sure screw up a lot of shit and make live miserable for
everybody for a long time.

144. Dunar  It remains to be seen what the case will be here
too.

145. Holt  Right and then you're not sure if the lower
agenda to have a department level space and technology
cabinet position is part of that scheme.  Then we're
definitely going to have to change our ways of doing
business to fit within something like that.  Because there's
been years that the guys at the White House didn't have a
clue as to who the agency had working at NASA.  We've not
been on the forefront of the national agenda for a long long
time, and we're not enjoying the limelight very much right
now.  These are times of great change, and there's great
change everywhere.  The technologies of the space station,

quite frankly there aren't great technologies in this
program.  Probably the biggest single difference is coming
up with coatings and stuff for thirty year programs -
analysis techniques and use of graphics and that type of
stuff.  A lot of that, when you start playing around with
crays to build it then what you're building is not as
important as the tools you use because now you can build
another one.  You always end up with these people who
evaluate what you, you know they take a look at your
computer and say well that's a 386 chip.  I can buy a 486 at
[514?] .  You sure can, but the problem is a 486 won't work
because it won't do [515?], and a 386 is out.  What do you
want to do?  On the same thing, Boeing has a chip they
developed on a 777 that will work.  You can play games in
the computer business today.  What is the technology?  I
don't care what you start with today, you're going to be
three years behind in a year and a half.  It always comes
down to what can I, do I have the skills and abilities to
manufacture?  That is unfortunately when you get into
programs and you stamp them up to big levels then they get
hung up on specs and requirements instead of what can you
do.

146. Dunar  That kind of points to the question too of
whether NASA has lost, whether through the demise of the
arsenal system and contracting, NASA's lost its ability to
be able to do that itself or even to monitor contractors.

147. Holt  I don't think so.  I don't think it lost any
capability.  I think what we've done is we've been lulled
into big heavy duty computerized documentation systems.  Now
we've got I think I mentioned that as soon as they took the
requirements to Restin the first thing they did was a
requirements review and wrote 7,000 changes to the basic
requirements.  There's no reason for that, but that's what
inexperienced people do is they try and nail it down so
tight that nobody can move instead of realizing that the
true negotiation leverage you have is to have a requirement
that has an interpretation on it and your contractors'
interpretation and your interpretation can be different.
Then you can have a real gut issue discussion of wether or
not it meets the requirement or not.

148. Dunar  In other words, if you have to pin it down too
much you then you're cutting out your own flexibility.

149. Holt  Right, and on costs plus contracts, you're going
to pay.  You want to try and minimize the number of changes
and fee claims and get back.  Every time you send a CCO out,
you suck up a $100K just on paperwork.  It doesn't matter.
In this program, when we did the restructure, the
preintegrated truss was CCO #69.  We're over #300 as of
right now.  A year later we were #169 and it has escalated
out of sight.  If you just take that on face value, at a

#100K a prop just to process paperwork just on the amount of
effort required by Mc Dac to run it through all the
organizations.

150. Dunar  Part of that too, at least when we've talked to
people at Marshall, part of the reaction to <u>Challenger</u> and
of being sure that you can detect and document everything .
. . .

151. Holt  Oh God yes.  Then you get into these requirements
and when you have a heavy-duty requirement spec, the bigger
the program requirement spec then the more you have to bend.
In each program there is a system, a CM system that checks
requirement numbers down to the CEI spec.  It's a monster.
Is it effective?  No.  Will it cover your ass?  Probably.

152. Dunar  Well that's a thing that they said too.  That
that's what you end up doing.  Some of this documentation is
strictly for that purpose.

153. Holt  It is strictly to cover the program manager's ass
on the day that something happened.

154. Dunar  Then on down the line too because each person
then has to do the same thing.

155. Holt   Ultimately, the change covers the program manager because it says, "No, no, no.  My system says that he told me that he implemented my requirement this way."  So the poor bastard that did it at the very farthest level down is the guy that gets pinned.  That's what happened to the poor bastard over at Huntsville.  The two guys that went out the door on Challenger were the guys who at the project level signed and told the program and the program in Shuttle kept meticulous books.  Burt Jackson's running control and configuration management of the Shuttle program.  [He] Came back out of retirement just for this purpose.  Every one of us and everybody says, "Oh crap!  Of all the people JSC could have sent up there why did it have to him.  Let's let Marshall do something!"

156. Dunar   Well I should end here.

157. Holt   I've enjoyed it.

158. Dunar   Well this has really been . . . . [stop tape 592]